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ALTERNATIVES EVALUATION FOR SITE G, SAUGET AREA 1 SITES SAUGET, ILLINOIS

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GERAGHTY & MILLER, INC.
Environmental Services

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Prepared for

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INTRODUCTION

In September 1994, the U.S. Environmental Protection Agency (USEPA) notified Monsanto of its intentions to conduct a removal action under the provisions of the National Contingency Plan (40 CFR 300) at Site G, in Sauget Area 1 located in St. Clair County, Illinois (Martin, pers. comm. 1994). The removal action contemplated by the agency at Site G consists of placement of an engineered clay cap over the surface of the disposal area (USEPA 1994).

Monsanto is currently engaged in discussions with the USEPA and the Illinois Environmental Protection Agency (IEPA) regarding Monsanto voluntarily implementing a remedial action at Site G. At Monsanto's request, in order to address concerns regarding the cap raised during a meeting between the parties on February 9, 1995, Geraghty & Miller, Inc. (Geraghty & Miller) has conducted an evaluation of a range of remedial options for Site G. The purpose of this evaluation is to compare the relative costs and benefits of the proposed capping alternative to other potential remedial alternatives for Site G. Based on the evaluation of alternatives, the cost-effective remedial response that is protective of human health and the environment will be identified for Site G.

SITE DESCRIPTION

Site G is an inactive, former industrial waste disposal area located in Sauget, St. Clair County, Illinois. The 4.5 acre site is within an area that has been designated as Area 1 by the IEPA, as part of the agency's Sauget Sites Project. Site G has been the subject of previous environmental studies conducted at the direction of the IEPA and the USEPA. The results of these studies were reported by St. John (1981) and Ecology & Environment, Inc. (1988 and 1994). The information presented in this section of the alternatives evaluation was originally presented in these reports.

Geraghty & Miller conducted a site visit in February 1995 to observe existing conditions at the site. A 6-ft high, chain link security fence has been installed around the entire perimeter of the site. The entrance gates to the site are secured with locked chains. The surface of the disposal area is presently overgrown with brush and vegetation, including a large number of secondary growth trees. Broken concrete and other materials resembling demolition debris were visible from the fenceline at a number of locations across the surface of the site.

WASTE CHARACTERIZATION

Ecology & Environment reported that industrial waste disposal operations at Site G began in the early 1950s and continued until the late 1960s (E&E 1988). Fill limits at Site G are constrained by Queeny Avenue to the north, Dead Creek to the east, the ridge which forms the property boundary to the south and the property boundary with the Wiese Engineering Company to the west. Site-specific geologic information presented by E & E (1988) indicates that the average thickness of waste found across the site is approximately 16 feet. Based on soil boring information, the greatest thickness of waste occurs in the west-central portion of the site, where roughly 30 feet of waste material was observed. The waste is described as black oily sludge, refuse and unknown wastes (E&E 1988). The waste is covered by surficial fill materials, which were found in all of the soil borings completed at the site by E&E. The fill material is described as consisting of very sandy, silty clay, mixed with cinders, slag and some gravel. The thickness of the surficial fill material is reported to range from 3 feet in the east end of the site to 12 feet in the western portion.

ESTIMATED VOLUME OF WASTE

Ecology & Environment (1988) estimated the volume of surficial fill material overlying the waste at Site G to be 22,000 cubic yards (CYs). The total volume of waste materials within the disposal area at Site G was estimated by E&E to be 60,000 CYs. Two separate pits containing oily tar materials were reported to be present in the north central and the northeast portions of the site (E&E 1994). General refuse and debris were also observed to be scattered across the site during an inspection conducted by the USEPA and the IEPA in May 1994 (E&E 1994).

NATURE AND EXTENT OF CONSTITUENTS

Samples of the surface soils and subsurface soils at Site G were collected by Ecology & Environment in 1987. The results of chemical analyses performed on these samples indicated the presence of various volatile and semi-volatile organic constituents, including pesticides and PCBs (E&E 1988). Groundwater samples were also collected from monitoring wells at Site G during the 1987 site investigation. Impacts to groundwater based on measurable concentrations of volatile and semi-volatile constituents were limited to on-site areas. Constituents of potential concern were not detected in monitoring wells downgradient of Site G.

Additional surficial soil sampling was conducted at Site G by Ecology & Environment in 1994. The analytical results confirmed the presence of soil constituents identified during earlier sampling events at the site, including volatile organics, semi-volatile organics and pesticides/PCBs (E&E 1994). Dioxins were also detected in the surficial soil samples collected during the 1994 sampling event.

HISTORIC WATER LEVEL DATA

Since 1983, Monsanto has been monitoring the elevation of the water table at the W.G. Krummrich Plant in Sauget, Illinois using continuous automatic water-level recorders. The well locations with recorders nearest to Site G are at the northeast corner of the plant near the intersection of Monsanto Avenue and Falling Springs Road (Well GM-1), and at the southeast corner of the plant near the intersection of Route 3 and the railroad tracks (Well GM-2).

The depth to water from the top of each well has been provided as a range of seasonal water-level fluctuation per year since 1983 (see Table 1). The 12-year record includes the draught period of 1988 through 1990 and the 500-year flood of 1993. Therefore, the effect of extreme climatic conditions on the groundwater system has been monitored continuously during the period of record. The range for the entire record for each well was converted to mean sea level (msl). Since Site G is hydraulically between Wells GM-1 and GM-2, but closer to Well

GM-2, we have estimated that the range of water table fluctuation at Site G is between 388 and 407 feet above msl.

In the past, large supplies of groundwater were withdrawn from local industrial wells for process water. State records show that a maximum of 35.5 million gallons per day (mgd) was being pumped from the local aquifer in 1962 and the water table in the area of Site G was lowered to an elevation below 370 feet above msl.

The elevation of land surface at Site G is about 408 feet above msl. During the period that the water table was depressed, it appears that excavation to a maximum depth of 36 ft below land surface occurred at Site G. However, as a result of the drastic reduction in groundwater withdrawal by industrial wells in the area, ~~the~~ influence of river stage and local rainfall events can drive the water table to an elevation of 407 ft msl, which is within one foot of the land surface at Site G. Based on the continuous water level record for the past 12 years, the water table was always at least 16 feet above the bottom of the waste material.

Based on the continuous water-level record, the water level at Site G fluctuates more due to seasonal changes than in response to the Mississippi River stage. However, at times of drought or flood conditions, the water table in the vicinity of Site G appears to be influenced by river stage. Historically, the highest river stage in St. Louis was recorded at an elevation of 429.44 ft msl (August 1, 1993), and the lowest river stage was recorded at 373.74 ft msl (January 16, 1940) (U.S. Army Corps of Engineers 1993). The highest and lowest annual mean elevations are 408.19 ft msl (1993) and 379.10 ft msl (1934), respectively.

During the 500-year flood of 1993, water levels at Wells GM-1 and GM-2 were recorded at their highest levels. During the drought conditions that occurred from 1988 through February 1990, the lowest river stage elevation recorded was 374.74 ft msl (December 23, 1989), just one foot above the 1940 historic low mark of 373.74 ft msl. The lowest recorded groundwater level in Well GM-2 occurred in January 1990 (386.2 ft msl), which coincides with the drought at that time, as well as with low river stage. Since the river stage in 1990 was only one foot higher than the record low mark, it is unlikely that water levels at Site G could decrease any lower than what was observed during the 1988 - 1990 time period.

DESCRIPTION OF ALTERNATIVES

Descriptions of each of the alternatives under evaluation are presented below. In addition to the remedial action activities that are specific to each of the alternatives, several other elements are common for Alternatives 2 through 4. These common elements would include tree removal, site grubbing and clearing, and consolidation and/or removal of the trees, brush, and non-hazardous surface debris that is present at the site.

Any pumpable oil waste that is present in the two small pits located in the northeast and east central portions of the site would be containerized and removed from the site for proper disposal. The residual solid and semi-solid tar-like wastes in these pits would be solidified/stabilized and consolidated on-site or removed for off-site disposal. Surface water that is accumulated in on-site depressions would also be removed and treated, if necessary, based on the results of water sampling.

ALTERNATIVE 1 - INSTITUTIONAL CONTROLS

Under this alternative, a groundwater monitoring program would be conducted and routine maintenance would be performed on the existing security fence.

ALTERNATIVE 2 - SURFACE CAP

Under this alternative, an engineered surface cap would be constructed over the waste disposal area at Site G. The surface cap would function to prevent direct contact with the wastes, as well as restrict the infiltration of rainwater through the underlying waste materials. The existing surface at the site would be regraded to establish the minimum slopes necessary to maintain surface water run-off and prevent erosion channelling.

Initial site work would include scarifying the existing vegetative cover and rough grading of the current cover materials using conventional excavation equipment. Common borrow materials would be imported from off-site and worked to obtain the grades needed for long-term slope stability prior to capping. For this analysis, we have assumed a two-foot layer of compacted clay would be used as the barrier layer for the surface cap. Detailed specifications for the cap would be developed in the design phase of the project. A frost protection layer, consisting of common borrow materials would be placed over the compacted clay layer. A vegetated topsoil layer would be added to enhance evapotranspiration and reduce erosion. Drainage controls at the site would also be improved to convey surface run-off from the cap during rainfall events.

Since it is reported that Site G only received industrial wastes during its operation, it is anticipated that landfill gas controls would not be required. However, the potential for landfill gas formation and migration is a design issue, which could be addressed during the design phase of the project. In the event landfill gas migration was determined to be a significant problem, a gas venting layer consisting of either a coarse grained soil or geosynthetic drainage material could be readily added to the surface cap design.

ALTERNATIVE 3 - IN-SITU SOLIDIFICATION/STABILIZATION

Under Alternative 3, the deep soil mixing technique would be used to provide in-situ solidification/stabilization of the buried waste materials at Site G. The process consists of in-situ mixing of one or more chemical reagents into a waste material in an attempt to modify the physical and chemical characteristics of the waste/soil matrix. In additional to the reagents commonly used for solidification (i.e., cement, lime, kiln dust and fly ash) of inorganic waste/soil mixtures, other chemical reagents may be required because of the presence of various organic constituents in the waste material at Site G. Bench-scale testing on waste/soil samples collected from the site would be required to determine the most effective additives and mixing ratio.

The deep soil mixing method utilizes crane-supported mixing shafts (usually a series of 1 to 4 leads) to inject and mix the reagents with the waste materials. As the mixing shafts are advanced from the ground surface to the bottom depth of the wastes, a slurry mixture of the reagents is injected through the hollow stems of the shafts. The estimated 60,000 CYs of waste materials and 22,000 CYs of surficial fill at Site G would be treated in-place by positioning the mixing shafts in overlapping patterns over the 4.5 acre surface of the disposal area.

Initial site work required for Alternative 3 would be similar to that described for Alternative 2. The existing vegetative cover would be scarified, followed by rough grading of the existing cover materials to provide a level surface for the deep soil mixing platform. In addition to the bench-scale testing discussed previously, pilot-scale testing on test plots would be required prior to full-scale implementation of this alternative.

Following completion of the in-situ solidification/stabilization, a soil cover would be constructed over the site. Drainage controls would also be improved to promote stormwater run-off.

ALTERNATIVE 4 - EXCAVATION /OFF-SITE DISPOSAL

Under this alternative the fill and waste materials at Site G would be excavated and transported off-site for treatment or land disposal, as appropriate. For the purposes of this evaluation, it is assumed that of the total 60,000 CYs of waste material at Site G, 20% is dioxin waste, 30% is hazardous waste and 50% is non-hazardous waste (Borries, pers. comm. 1995). All dioxin and hazardous wastes excavated from Site G would be incinerated off-site. Non-hazardous wastes and the 22,000 CYs of surficial fill would be transported to an off-site land disposal facility.

A large-scale dewatering program would have to be implemented under Alternative 4, since a large portion of the buried waste material is below the water table. Excavation of large volumes of saturated materials is impractical because of problems associated with sloughing and failure of the sideslopes, and heaving of the excavation bottom. Since the drawdown requirements for dewatering exceed the suction-lift capacity of conventional well point systems (approximately 15 ft), a high capacity deep well system would be required. Based on previous dewatering projects conducted in the Sauget area, it is anticipated that a cumulative pumping rate of at least 1,000 gallons per minute would be required to lower the water table below the bottom elevation of the waste materials at Site G (36 feet below grade). This corresponds to a daily discharge rate of 1.4 million gallons. Temporary treatment facilities would be required onsite to treat the recovered groundwater prior to discharge. In addition, under this alternative, approval would have to be secured for temporary discharge of the treated water to the river or to the American Bottoms Sewage Treatment Plant.

During the preliminary evaluation of Alternative 4, the option of treating the excavated fill and waste materials on-site utilizing ex-situ solidification/stabilization was considered, but not retained for more detailed evaluation. Since portions of the waste materials at Site G are likely heterogeneous in nature, the excavated wastes would have to be segregated prior to undergoing on-site solidification/stabilization. This would increase the amount of waste handing required, and increase the exposure of on-site workers to waste materials. The excavated waste materials may also be subject to the Land Disposal Restrictions (LDRs) and Universal Treatment Standards. Depending on the level of treatment achieved, minimum technology requirements associated with RCRA disposal cells might still be applicable, even after treatment.

EVALUATION OF REMEDIAL ALTERNATIVES

Each of the alternatives described in the previous section are evaluated below on the basis of effectiveness, implementability and relative cost. The effectiveness criterion considers the degree to which each alternative would reduce the potential risks to public health and risk to public health and the environment posed by the site. Under the implementability criterion, the ease with which the alternative could be constructed, given the specific site conditions was examined. The relative costs of each of the alternatives were estimated using unit costs and the preliminary estimates of waste quantities.

EFFECTIVENESS

Alternative 1 (Institutional Controls) would provide a moderate degree of effectiveness. Although the existing security fence restricts access to the site, it does not eliminate the potential for unauthorized entry. The potential for the airborne release of surficial soil/waste constituents is not addressed, and surface water run-off from the site would remain uncontrolled. The groundwater monitoring component of Alternative 1 would provide an effective means of detecting any changes in groundwater quality at the site.

Alternative 2 (Surface Cap) would provide a high degree of long-term effectiveness and permanence in eliminating potential health risks associated with direct contact or the airborne release of surficial waste/soil constituents from Site G. The relatively impermeable clay cap would also reduce the amount of rainfall induced infiltration that would come into contact with the buried waste materials. Alternative 2 would also have a high level of short-term effectiveness since the potential exposure of on-site workers to the waste materials would be limited to the initial grading activities.

Alternative 3 (In-Situ Solidification/Stabilization) would provide a similar degree of long-term effectiveness as that provided by Alternative 2. While there is a potential to reduce leaching from the portion of buried wastes at Site G which are saturated, the permanence of the stabilization reactions for organic wastes are uncertain, particularly under saturated conditions.

Alternative 4 (Excavation/Off-Site Treatment) would result in the highest degree of long-term effectiveness in the elimination of potential health risks since the waste materials would be permanently removed form the site. However, potential short-term health risks are significantly increased under Alternative 4 as a result of multiple exposures to the waste constituents due to the excessive handling of the materials. Alternative 4 poses the greatest potential health risk to on-site workers and area residents, as a result of exposure to waste constituents during excavation and transportation activities. Excavation of the waste materials also increases the potential for a release of waste constituents to other environmental media at Site G.

IMPLEMENTABILITY

Alternative 1 could be readily implemented at Site G. A security fence to restrict access to the site, as well as the monitoring wells required for the groundwater monitoring program are already in place.

Alternative 2 could also be readily implemented. The construction methods and testing procedures for clay caps are well documented. The personnel, equipment and materials required to install the clay cap are available locally. The need for specialized health and safety precautions during construction would be limited to the initial rough grading activities. Thereafter, normal procedures for routine earthmoving projects could be followed. A major advantage of Alternative 2 would be the ability to implement an effective quality assurance/quality control (QA/QC) program during installation of the clay cap. Testing of the construction materials and methods can be performed as the work progresses, to confirm that performance criteria established for the cap would be met.

Alternative 3 would be more difficult to implement than Alternatives 1 and 2, due to the large volume of material to be treated and the expected heterogeneous nature of the buried wastes. Deep soil mixing has been used traditionally to modify native soils for geotechnical purposes. The presence of subsurface obstructions (such as refuse and demolition debris) may prevent the mixing shafts from advancing through the waste/soil column to be treated. In addition, the ability to achieve a uniform mixture of waste and reagents is seriously compromised when heterogeneous waste, such as those expected at Site G, are present.

Alternative 4 would be the most difficult alternative to implement. Data previously discussed, indicate that historically, the water table has been at least 16 feet above the bottom of the wastes, since high capacity industrial pumping in the area was discontinued. In addition, a minimum of 1,500 truck loads would be required to transport the estimated 30,000 CYs of dioxin and hazardous waste materials to the nearest off-site incinerator permitted to burn dioxin (a commercially-owned incinerator in Coffeeville, Kansas). An additional 2,600 truck loads would be required to transport the estimated 30,000 CYs of non-hazardous waste materials and 22,000 CYs of affected surficial fill material to a land disposal facility. The transport activity would be disruptive to the local community and would result in the potential for multiple exposures to the waste constituents due to the excessive handling of the materials.

RELATIVE COSTS

The costs associated with Alternative 1 are for periodic fence maintenance and groundwater sampling at existing Site G monitoring wells. The estimated annual cost for these activities is $20,000.

Based on Geraghty & Miller's experience, a representative cost range for construction of a clay cap is $5.50/SF to $6.50/SF. Using the upper end of this cost range and assuming that the area to be capped at Site G is 4.5 acres (196,020 SF), the estimated cost for Alternative 2 is $1,700,000. This estimated cost includes a 30% contingency for project management, engineering and unforeseen changes in scope.

Typical unit costs for in-situ solidification/stabilization based on vendor-supplied information are $75/CY to $140/CY. The estimated volume of buried waste and affected fill materials at Site G is 82,000 CYs. Since a large portion of the buried material is saturated, we have assumed the higher end of this unit cost range for the purposes of this evaluation. At $140/CY the estimated cost for solidification/stabilization under Alternative 3 is $11,500,000. The estimated cost for construction of a soil cover over the solidified materials is approximately $600,000. This estimate is based on an assumed unit cost for the soil cover of $3.00/SF and a total area for the cover of 4.5 acres (196,020 SF). The total estimated cost for Alternative 3 is $15,700,000. A 30% contingency is included in the cost estimate for this alternative for project management, engineering and unforeseen changes in scope.

The costs associated with Alternative 4 would include the costs for dewatering, water treatment, excavation, transportation and disposal costs at the off-site facility. The estimate for this alternative does not include the costs for dewatering, water treatment, excavation or transportation of the wastes to the treatment or disposal facility. Although these costs would be significant, they are not included in the relative cost comparison because of the magnitude of the treatment costs for Alternative 4. For the purpose of this estimate, 12,000 CYs of dioxin waste, 18,000 CYs of hazardous wastes and 30,000 CYs of non-hazardous wastes are assumed to be present at Site G. Under current Monsanto contracts, unit pricing for the incineration of dioxin and hazardous wastes is $3.00/pound and $0.45/pound, respectively. Unit costs for land disposal of the non-hazardous wastes are $40 to $50/ton. The upper end of this range was used for cost estimation purposes. Based on these unit costs and the estimated volumes of waste materials requiring treatment/disposal, the disposal costs alone for Alternative 4 are approximately $120 million. A summary of the estimated costs for each of the alternatives is presented in Table 2.

The costs associated with certain remedial elements that are common to Alternatives 2 through 4 (e.g. site clearing, removal of ponded water, etc.) have not been estimated. These costs are minimal compared to the estimated cost for each of these alternatives.

RECOMMENDED ALTERNATIVE

Based on the results of the comparative analysis presented in the preceding section, Alternative 2 is the recommended alternative for Site G. Alternative 2 would have a high degree of effectiveness, and is comparable to the other alternatives evaluated in its overall protection of human health and the environment. Excluding Alternative 1 (Institutional Controls), it would be the most readily implemented of the alternatives considered, and also is the cost-effective alternative based on benefits derived from expenditures.

REFERENCES

Borries, S. 1995. U.S. Environmental Protection Agency. Telephone conversation with J. Hanson, Monsanto Chemical Company, February 17, 1995.

Ecology & Environment, Inc., Expanded Site Investigation , Dead Creek Project Sites at Cahokia/Sauget, Illinois, May 1988.

Ecology & Environment, Inc., Removal Action Report for Sauget Area 1, Site G, Sauget, St. Clair County, Illinois, August 19, 1994.

Martin, T.J. 1994. U.S. Environmental Protection Agency. Letter to S. P. Krchma, Environmental Counsel, Monsanto Chemical Company, September 21, 1994.

St. John, R. 1981. A Preliminary Hydrogeologic Investigation in the Northern Portion of Dead Creek and Vicinity, Illinois Environmental Protection Agency, Division of Land Pollution Control.

U.S. Army Corps of Engineers. 1993. River Stage Data for the Mississippi River at St. Louis, Missouri.

U.S. Environmental Protection Agency. 1994. Request for a Time-Critical Removal Action at Sauget Area 1, Site G, Sauget, St. Clair County, Illinois. Chicago, Illinois, 7 pp.

TABLES

Table 1. Water Level Data, Sauget, Illinois.

Year	GM-1[a] (Depth to water in feet below measuring point)	GM-2[b] (Depth to water in feet below measuring point)
1983[c]	15.2 - 17.6	23.8 - 26.2
1984	9.5 - 15.2	14.8 - 24.4
1985	10.2 - 16.2	18.6 - 24.2
1986	12.1 - 16.8	17.2 - 23.2
1987	13.2 - 17.0	18.6 - 23.5
1988	12.6 - 21.2	18.9 - 27.8
1989	18.3 - 21.4	26.2 - 29.2
1990	13.8 - 22.6	18.8 - 31.2
1991	12.6 - 16.8	17.0 - 23.5
1992	13.2 - 17.4	18.4 - 23.5
1993	7.9 - 14.0	9.8 - 19.4
1994	8.3 - 16.3	12.8 - 22.8
1995[c]	14.7 - 16.5	21.8 - 22.9
Range (ft below measuring point)	7.9 - 22.6	9.8 - 31.2
Range (ft above msl)	(405.8 - 391.1)	(407.6 - 386.2)

[a] Measuring point is 413.7 ft above mean sea level (msl).
[b] Measuring point is 417.4 ft above msl.
[c] Water level data exists for only part of the year.

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Table 2. Cost Summary for Remedial Alternatives, Site G, Sauget, Illinois.

Alternative	Estimated Quantity	Unit Cost ($/unit)	Total Cost ($)
Institutional Controls	1 LS	20,000/YR	20,000
Surface Cap	196,000 SF	6.50/SF	1,700,000 [a]
In-Situ Solidification/ Stablization	82,000 CYs	140/CY	14,900,000 [a]
	196,000 SF	3.00 SF	800,000 [a]
			15,700,000
Excavation/Off-Site Treatment	12,000 CYs	3.00/LB	97,000,000 [b]
	18,000 CYs	0.45/LB	22,000,000 [b]
	52,000 CYs	50/TON	3,500,000 [b]
			122,500,000

(a) Cost includes 30% contingency factor for project management, engineering and unforeseen changes in scope.

(b) Assumes 2,700 pounds per cubic yard of soil/waste.

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